Presentation at the Second Plenary Meeting of the Advisory Committee on Acoustic Impacts on Marine Mammals

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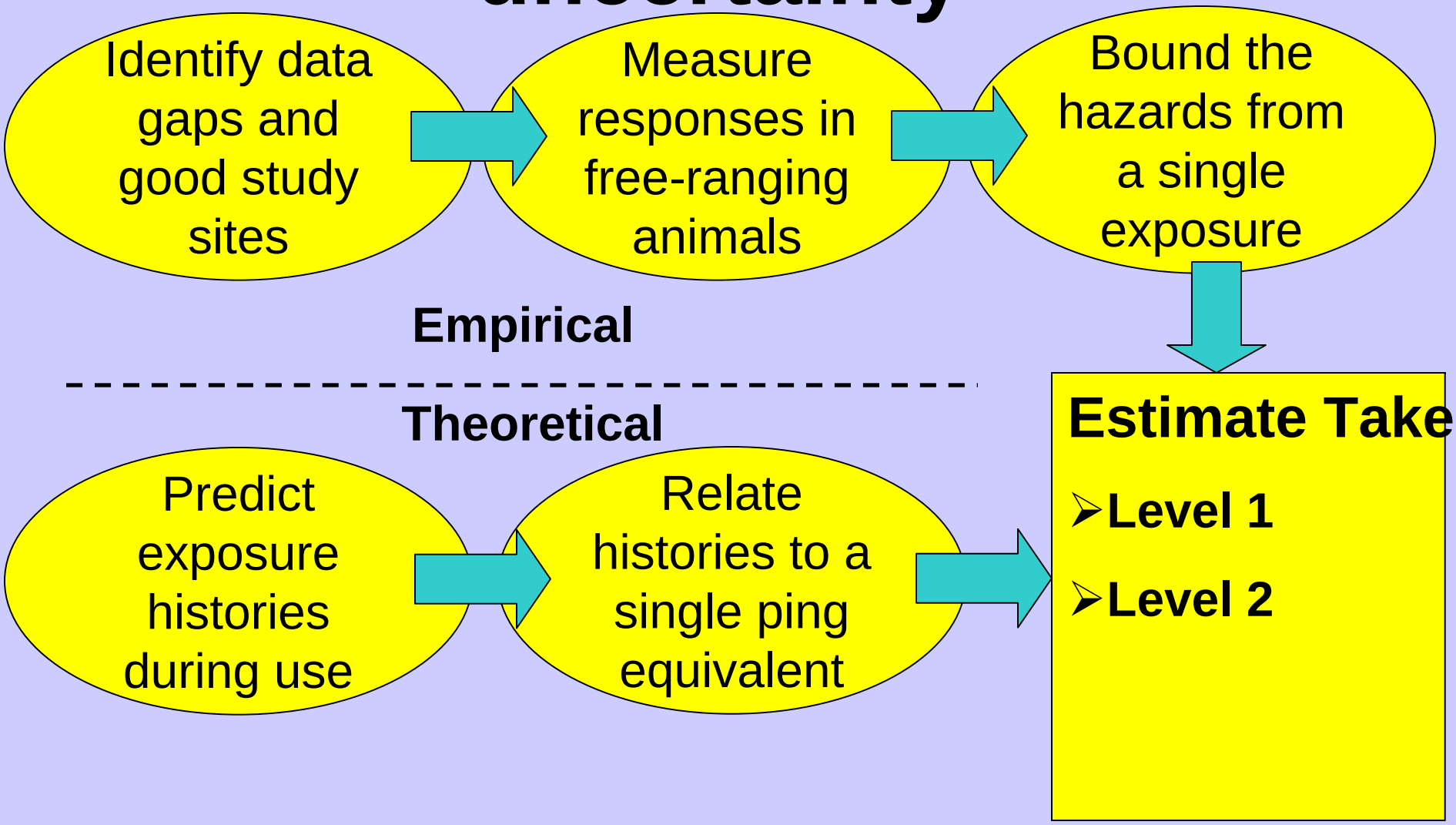
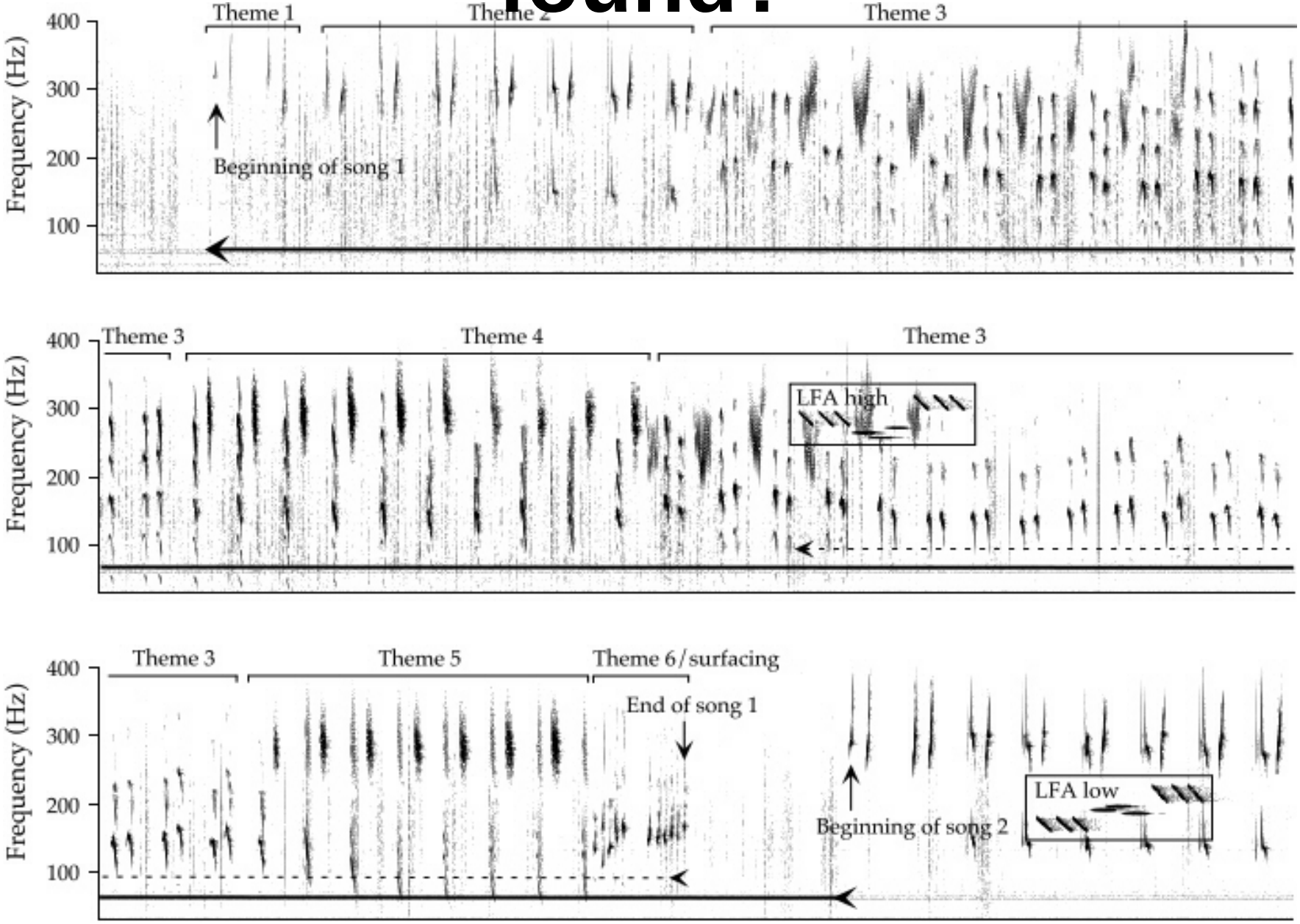
# Transparent Reasoning About Unmeasured Risks: The USN LFA Sonar EIS

Kurt Fristrup, Ph. D.
Bioacoustics Research Program
Cornell Lab of Ornithology

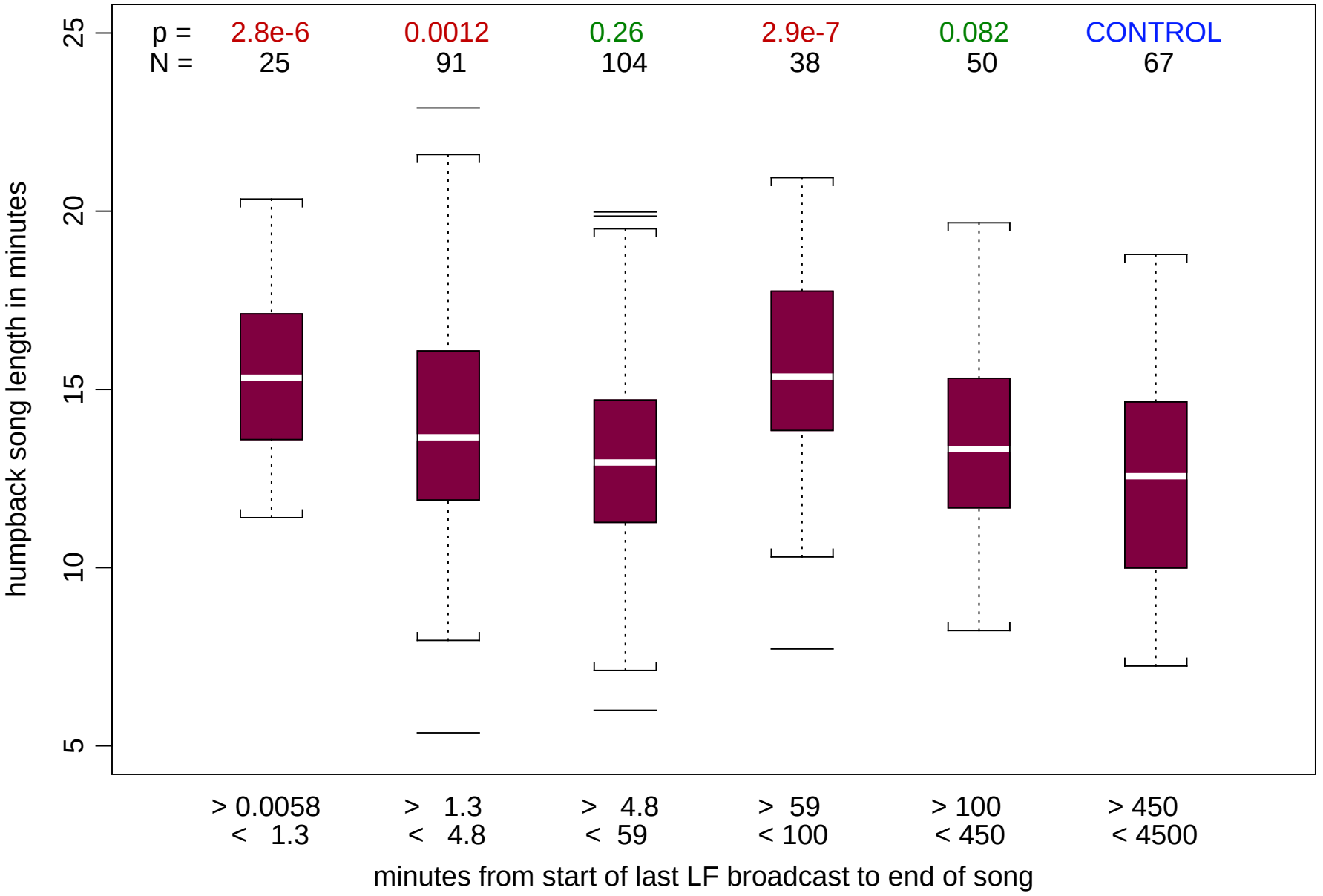
# Parse the complex problem isolate sources of uncertainty



# What kinds of responses were found?

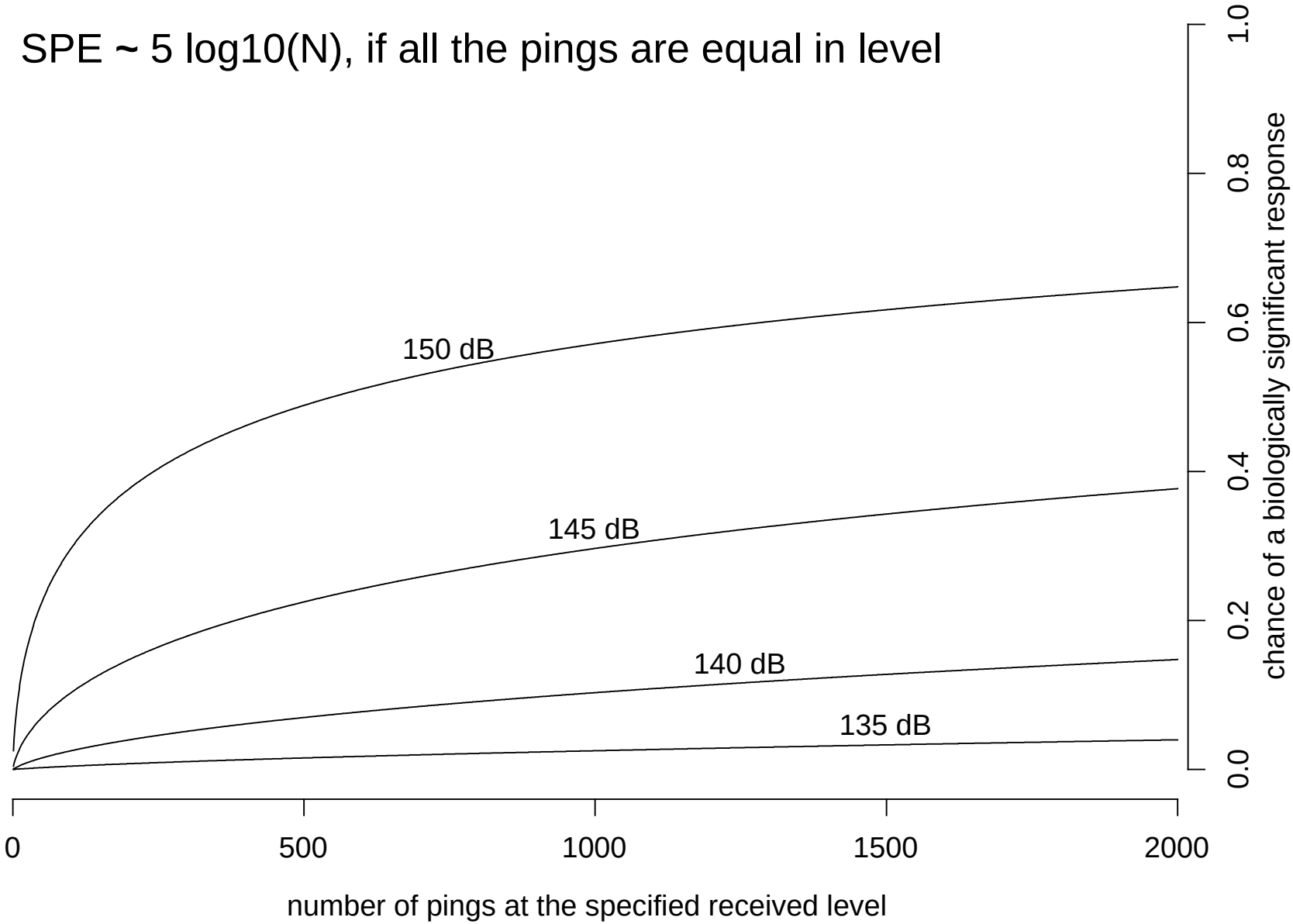


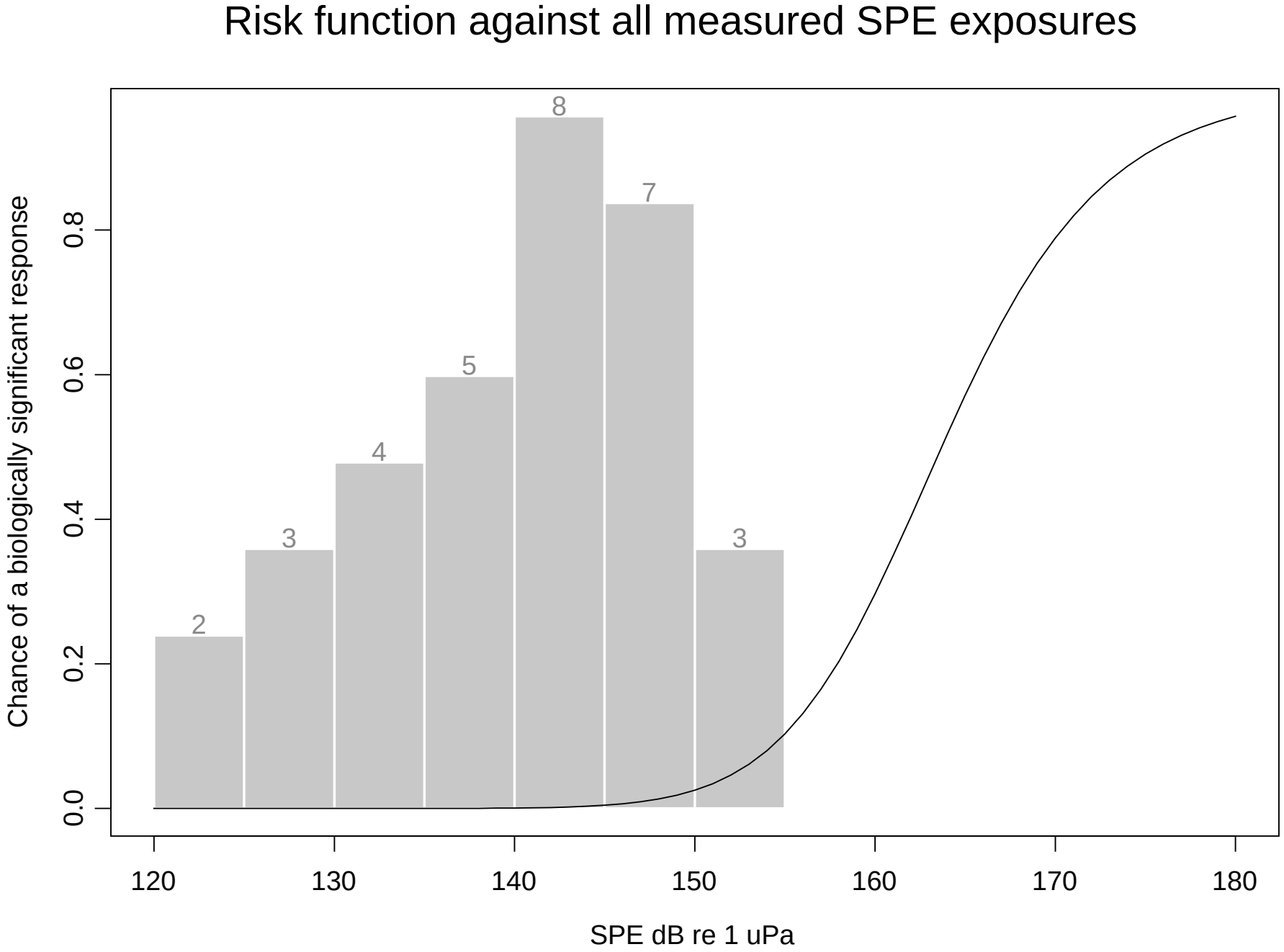
# Changes in Song Length vs. Time since last Ping



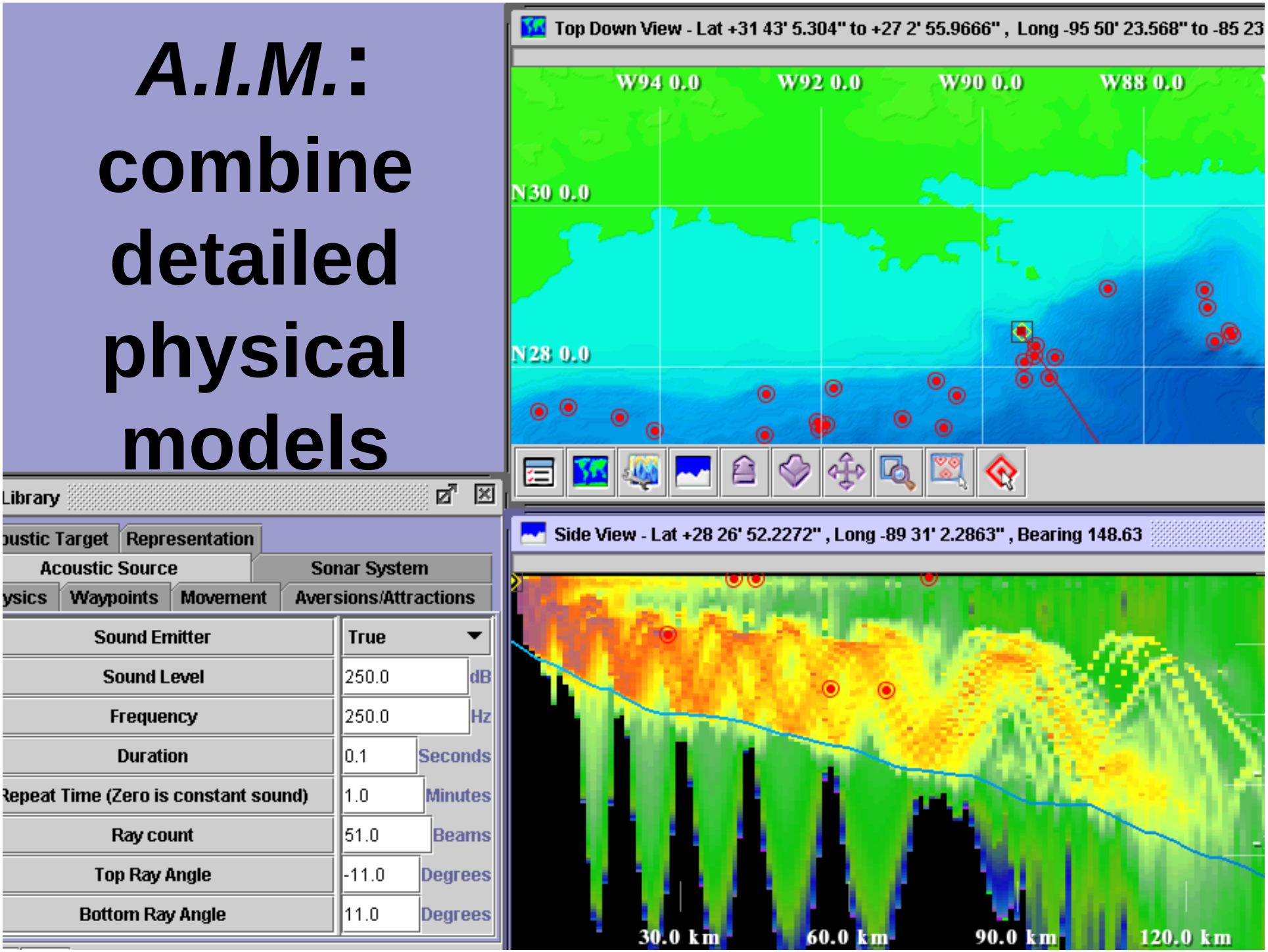
# Cumulative effects: the single ping equivalent (SPE) model

SPE ~ 5 log10(N), if all the pings are equal in level

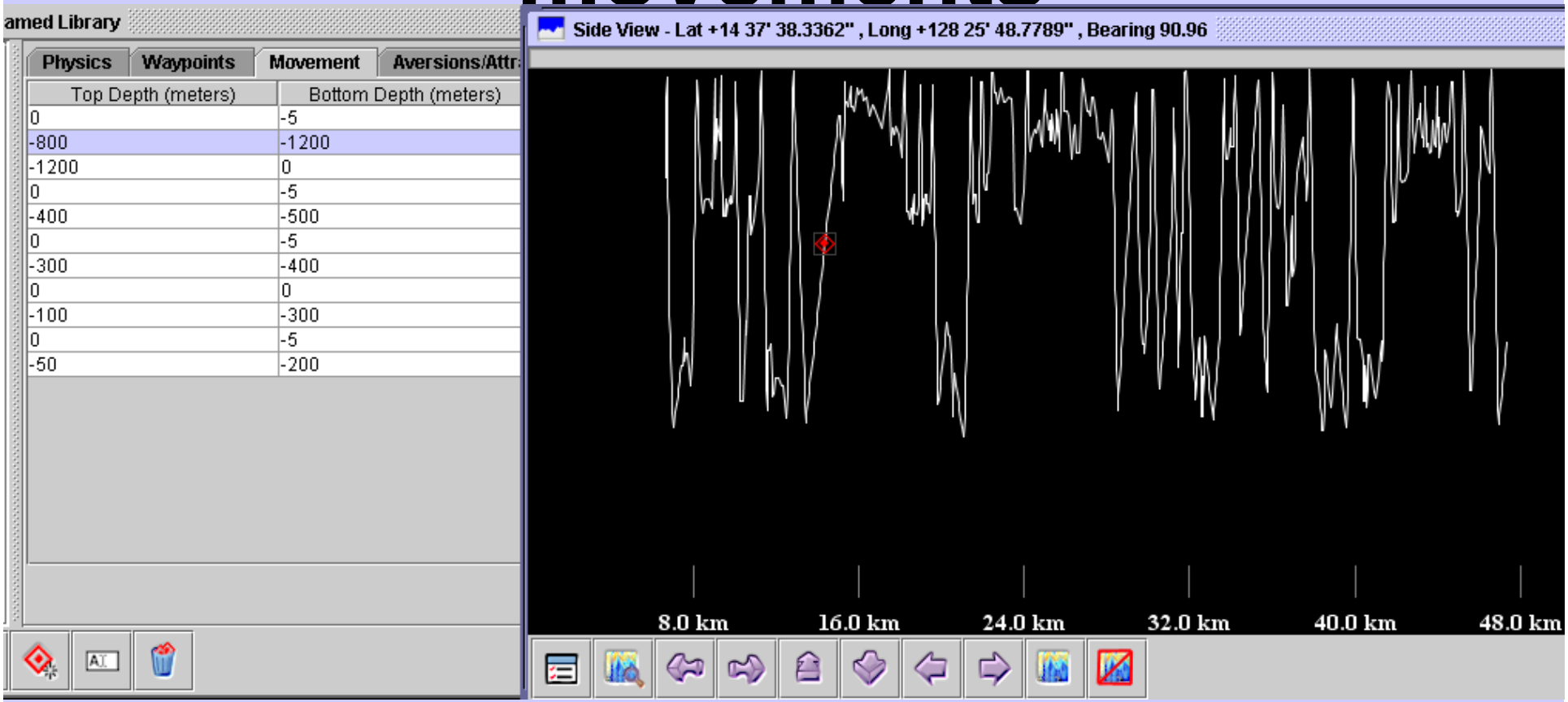



Risk function against all measured SPE exposures
Chance of a biologically significant response
0.0
0.2
0.4
0.6
0.8
2
3
4
5
8
7
3
120
130
140
150
160
170
180
SPE dB re 1 uPa

# *A.I.M.*: combine detailed physical models



# with simulations of animal movements

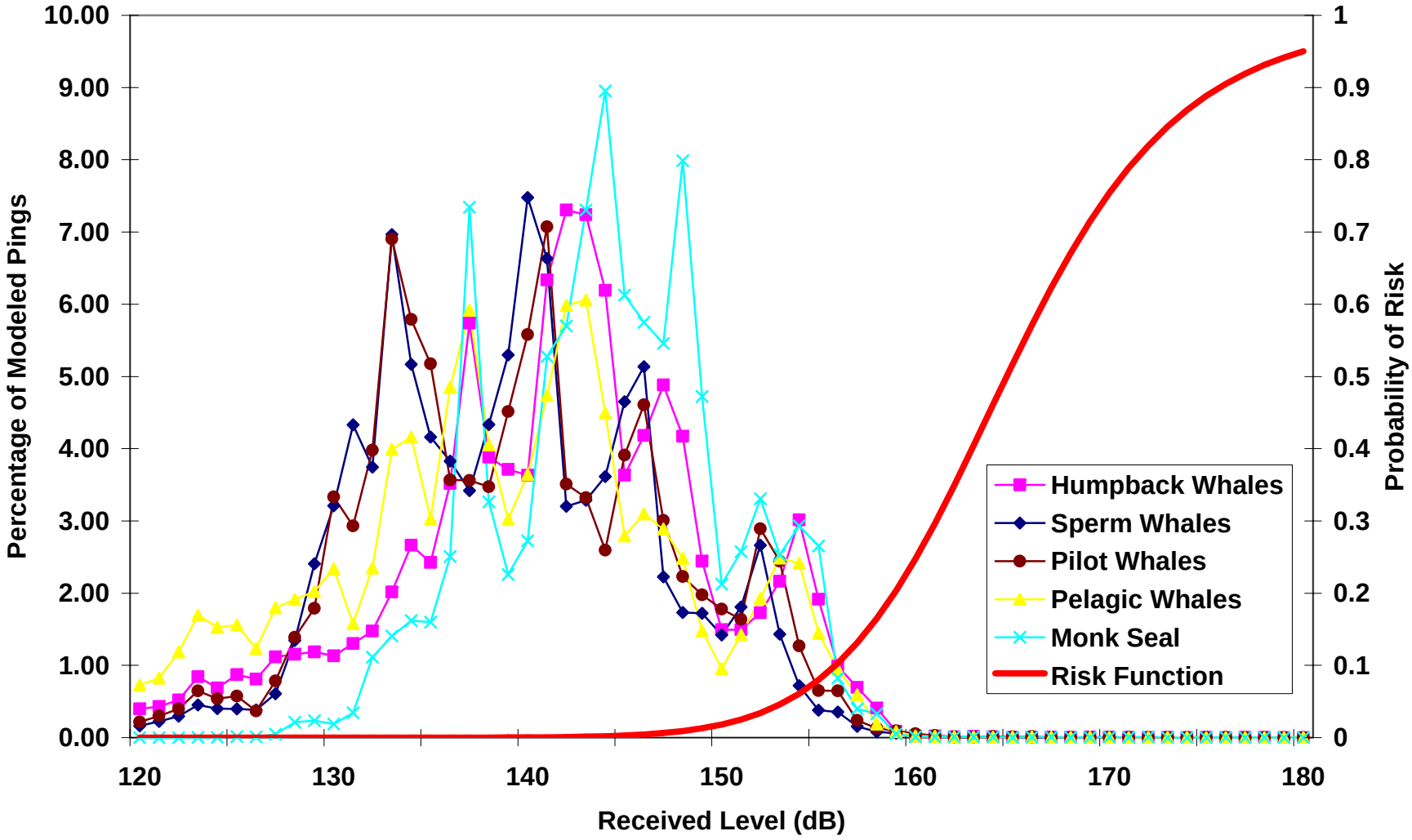


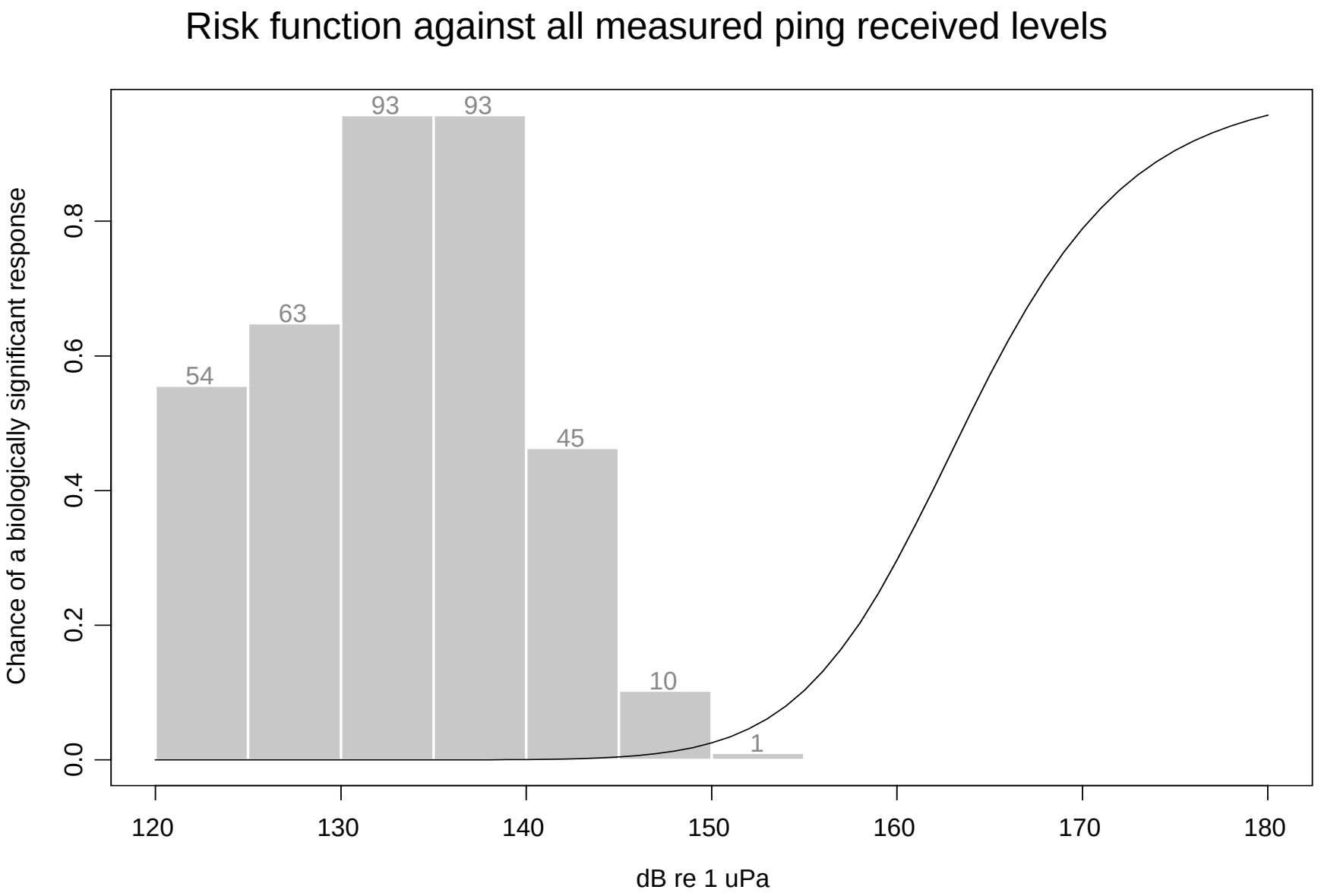

**"Application of the Acoustic Integration Model (AIM) to predict and minimize environmental impacts"**

A. S. Frankel, W. T. Ellison, J. Buchanan, IEEE Oceans 2002

# Acoustic Integration Models and Risk Continuum

## All Species - Northwest of Kauai, HI (Site 12)




Risk function against all measured ping received levels
Chance of a biologically significant response
0.0
0.2
0.4
0.6
0.8
54
63
93
93
45
10
1
120
130
140
150
160
170
180
dB re 1 uPa

# A simple threshold for potential injury was used

- The SRP data could not be related to a dose-response model for injury
- ***A priori*** knowledge indicated that injurious effects would be limited to very few individuals
- ***A.I.M.*** modeling of many sites did not raise the need for dose-response

# 688 pages in 56 words (table 4.2-10)

31 sites, 200 species-site combinations were modeled. ***In the absence of mitigation:***

- more than 5% of a stock would be harassed at 22 species-sites,
- more than 1/1000$^{th}$ of a stock would experience a level exceeding 180 dB at 55 species-sites,
- high latitude and confined sites posed the highest impacts.

# Fostering objective assessment

- **Explicit models that expose their assumptions should promote productive discussion**
- **Uncertainty can be addressed by examining the sensitivity of modeled results to variation in the control parameters**
- **All opinions are biased. Utilize a peer-reviewed process wherever possible. For the EIS, 27 researchers participated as critical reviewers (authors of more than 580 journal articles).**